Supplementary Information for

A rod-shaped liquid plasticine for gas diffusion detection

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1. Production of sol-gel coated petri dishes

The superhydrophobic SiO_2 coating with weak binding forces was prepared by a sol-gel method as described elsewhere[1,2] and summarized below.

A silica sol was synthesized with tetraethyl orthosilicate (TEOS) as the precursor, in ethanol (EtOH), with a molar ratio that was adjustable within a certain range. Here, the molar ratio was TEOS/EtOH/NH_3/H_2O at 1/38/1.08/3.06 (all water was from the 25% ammonia solution, and the volume ratio was TEOS/EtOH/ammonia solution at 5/50/1.8). First, EtOH was mixed with TEOS with stirring for ~15 min. Then, ammonia solution was added and stirred for 1 h. The mixed solution was subjected to aging at room temperature for 7 d to form a SiO_2 sol, after which it was suitable for coating. Hexamethyl disilazane (HMDS) was then added into the sol with stirring for ~2 h for alkylation (molar ratio, TEOS/HMDS at 1/0.6 and volume ratio, TEOS/HMDS at 5/2.82). The alkylated SiO_2 sol was subjected to aging for 1 d, after which it was ready for use. Pouring the alkylated SiO_2 sol into a petri dish to wet its inner surface and then pouring the sol out, gave rise to a coated petri dish after air drying for ~5 min. The obtained sol-gel coating consists of layers of hydrophobic SiO_2 nanoparticles (NPs), whose outermost layer were transferable by contacting with water solutions.

2. Preparation of phenolphthalein solution

To prepare the solution for NH_3 detection, 0.05 g phenolphthalein was dissolved in 13 mL ethanol and then mixed with 130 mL water. Because phenolphthalein is insoluble in water, precipitation was found after preparation for 24 h. Accordingly, the experiments were carried out with fresh solutions each time.

3. Production of rod-shaped liquid plasticine

When the liquid pancake was covered by jammed NPs after shaking manipulation, it was cut using a hydrophobic tool, a plastic dropper in this work, to produce an initial liquid rod with a certain length. The rest liquid entities were cut into small pieces and then pushed to the ends of the liquid rod using the plastic dropper. Then, the liquid rod length was increased via a joining process and then its shape was optimized by further operations including pushing, cutting, and liquid addition. Finally, the residue liquid entities were sucked out using tissues

4. Theoretical derivation

Fick's second law relates a diffusive gas's concentration with diffusion time and position and, here, it was used for the modeling purpose. Considering that the height of the petri dish was much less than the length and width, the diffusion in *z* direction was ignored for simplification, and thus the two-dimensional (2D) form of Fick's second law was employed:

$$\frac{\partial c}{\partial t} = D\left(\frac{\partial^2 c}{\partial x^2} + \frac{\partial^2 c}{\partial y^2}\right) \quad (1)$$

where *c*, *t*, *D* refer to the concentration, diffusion time, and diffusion coefficient of a diffusive gas, respectively. Solving Eq (1) requires a model with specific starting and boundary conditions. The μL-level ammonia droplets were generated rapidly, and their large specific surface areas and high concentration (25 wt%, undiluted ammonia solution) should largely benefit NH_3 volatilization. These indicated that the point source model is applicable here in which all diffusive substances are supposed to concentrate in a point when $t = 0$. The analytical solution by using this model for

diffusion in an open space is known as:

$$c(x,y,t) = \frac{m}{4\pi Dt} exp(- \frac{x^2 + y^2}{4Dt}) \quad (2)$$

where *m* is the diffusive gas mass. Because the diffusion in our experiment proceeded toward one side, *m* should be doubled. In addition, considering the reflection effect, two image sources were set as schemed in the main text, therefor, the gas concentrations generated by the real (c_0) and image (c_+ and c_-) sources are presented as Eq (3)-Eq (5), separately, and the actual gas concentration is equal to their sum, as Eq (6).

$$c_0(x,y,t) = \frac{m}{2\pi Dt} exp(- \frac{x^2 + y^2}{4Dt}) \quad (3)$$

$$c_+(x,y,t) = \frac{m}{2\pi Dt} exp(- \frac{y^2 + (x + 2L)^2}{4Dt}) \quad (4)$$

$$c_-(x,y,t) = \frac{m}{2\pi Dt} exp(- \frac{y^2 + (x - 2L)^2}{4Dt}) \quad (5)$$

$$c(x,y,t) = c_0(x,y,t) + c_+(x,y,t) + c_-(x,y,t) \quad (6)$$

$$= \frac{m}{2\pi Dt}[\exp\left(- \frac{x^2 + y^2}{4Dt} \right) + \exp\left(- \frac{y^2 + (x + 2L)^2}{4Dt} \right) + \exp\left(- \frac{y^2 + (x - 2L)^2}{4Dt} \right)]$$

When x = 0, there is:

$$c(y,t) = \frac{m}{2\pi Dt}[\exp\left(- \frac{y^2}{4Dt} \right) + 2\exp\left(- \frac{y^2 + 4L^2}{4Dt} \right)] \quad (7)$$

which derives:

$$y = \sqrt{4Dt \times ln \frac{m(1 + 2exp(- \frac{L^2}{Dt}))}{2\pi Dct}} \quad (8)$$

Eq (2), (7), (8) correspond to Eq (1), (2), (3) in the article, respectively.

Reference

(1) Li, X. G.; Xue, Y. H.; Lv, P. Y.; Lin, H.; Du, F.; Hu, Y. Y.; Shen, J.; Duan, H. L. Liquid plasticine: controlled deformation and recovery of droplet with interfacial nanoparticle jamming. *Soft Matter*. **2016**, *12*, 1655-1662.

(2) Li, X. G.; Shi, H. X.; Wang, Y. Q.; Wang, R. X.; Huang, S.; Huang, J. C.; Geng, X. G.; Zang, D. Y. Liquid shaping based on liquid pancakes. *Adv. Mater. Interfaces*. **2018**, *5*, 1701139.